The Story of the
TYPEWRITER

From the Eighteenth to the Twentieth Centuries

By RUPERT T. GOULD

Edited by
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With a Foreword by
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FOREWORD

by MANCELL GUTTERIDGE, ESQ.

President of the Typewriter (and Allied) Trades Federation of Great Britain and Ireland

The evolution of the typewriter must, I feel sure, have a universal appeal and this booklet—the first of its kind, I believe—will be a source of interest and delight.

The booklet traces the history of the typewriter from the time of the invention of the first crude writing machine to the typewriter of present-day excellence, and the late Commander Gould has presented his facts in a readable and interesting form.

Queen Anne is undoubtedly dead, but the invention of the writing machine in 1714 keeps her memory alive and thrice blessed by all typists, clerks and executives who would otherwise be condemned to the drudgery of hand-written communication.

The 'History of the Typewriter' deserves its place on every book-shelf.

INTRODUCTION

It is my privilege, albeit a sad one, to introduce this monograph; written, and rewritten, at intervals over the past two decades, it represents the fruits of many years' study of the absorbing story of the development of the modern typewriter, a story that the late Lieutenant-Commander Rupert T. Gould, R.N., succeeded in clothing with something akin to romance, without ever departing from strict historical accuracy. In this work I had a double interest, both as editor during the first publication of his work in the pages of *Office Control and Management* last year, and as a personal friend of fifteen years' standing.

To appreciate Rupert Gould you had to know him; to a stranger he might on occasion seem morose or moody, he might lead the conversation round to an erudite discussion on such unusual subjects as the Loch Ness monster, nautical chronometers, the development of tobacco-smoking, or the mathematical calculations necessary to ensure success at any nominated billiard stroke—he was an enigma.

Our friendship started in 1934: among the summer visitors to the hotel on the cliffs, among the average holiday crowd, one figure stood out, both physically—for he was tall and bulky in proportion, with a massive and almost leonine head—and in his behaviour, for this extraordinary man spent most of his spare time building an enormous box kite. An acquaintanceship ripened into friendship, on which the seal was set by my participation in the experimental launching of the kite, on a suitably windy day, to study the behaviour of such large-scale toys which in recent years have been put to a practical wartime use. The story of that experimental morning, of the kite soaring aloft and nearly taking us with it (until the line was made fast to a corporation lamp-post which nearly became airborne), of the line giving way and the kite crashing over the roof tops, of our gallant rescue of its remains from private property—all that is another story.

We found, in that coincidental manner that so often marks chance meetings, that we both lived in Surrey, in adjoining towns; on regular evenings over the next year or so we met for snooker or billiards, of which he was no mean exponent, followed by, for me, an exploration of his workroom.

Imagine a large, long and airy loft, with dormer windows, running the whole length of a good-sized house, the entire wall space fitted with shelves, the furniture consisting mainly, and at first glance solely, of large tables and workbenches piled high in orderly confusion; a paradise for a browser. Every time we met I discovered another angle on this man, another activity or interest at which he excelled—writer, artist, dilettante, with the mechanical and analytical mind that produced the inquisitive mentality, the patient research, the gift of clear thinking, which together gave 'Stargazer' (alias R. T. Gould) his success as a broadcaster, were later put to such effect in the Brains Trust, and enabled him to write with authority on wind currents or time-keepers, on the Indian rope trick or sea serpents.

But what about typewriters, you ask? That room at Ashtead supplies the answer—at least half the shelving housed a veritable museum of ancient machines, all in working order, all milestones in the history of mechanical writing. On the door of this room was a notice:

HOME OF REST FOR AGED AND DECAYED TYPEWRITERS
SUPPORTED ENTIRELY BY VOLUNTARY CONTRIBUTIONS
NO DESERVING CASE EVER REFUSED ADMISSION

For many years he had carried on his research into the story of their development, and, as the only private collector of these machines in this country, his knowledge was unique. It was not as a dabbling amateur that he addressed the Royal Society of Arts in 1928, with the Director of the Science Museum in the chair, or broadcast on the same subject ten years later; it was not from a mere hobbyist that the South Kensington museum purchased many of his specimens for the National Collection, from which I have selected the illustrations to his monograph.

* * *

In recent years, alas, his health was not good; a stroke during the war years restricted his activity, but his brain remained clear, and he kept up his correspondence—a typewriter becoming easier for him than manuscript. But he weakened gradually, and died on the 9th October, 1948.

As the historian of the invention and development of the typewriter, he brought a fund of learning and research, an astonishingly varied knowledge of 'oddities,' and a painstaking, scientific, analytical mind salted with fair judgment and spiced with humour. The national Press has already paid tribute to his great work on the history of the marine chronometer, and to the practical example of his mental skill in the repair by his own hands of the four eighteenth century Harrison chronometers at Greenwich, a task which took him thirteen years. His more 'popular' activity as an original member of the 'Brains Trust' has been recalled, and the versatility and imagination of his earlier works such as *Oddities*, or *Enigmas*, have been praised.

Little has been said, however, of two other activities, one appealing to many, the other to a small circle. The first was his delightful series of broadcast talks to children as 'Stargazer', talks which admittedly covered again many of the curiosities and exceptional things of which he had written in his earlier books. But a copy of any of the 'Stargazer' books, reprinting his talks, will convince the reader that this was no dry-as-dust scientist but a big-hearted avuncular curiosity himself! The other activity, his last, was the research into the history of the typewriter that has resulted in this posthumous work.

His own collection of historic machines, formed from 1927 onwards (and from which, as I have mentioned, the National collection at South Kensington was enriched) was loaned a few years ago—and has now been bequeathed—to the Chiswick Polytechnic for the benefit of future generations of students; there they survived the war, although the building was partly damaged, and I saw and handled them a year ago, still parcelled and docketed with that methodical efficiency that was so much a part of Rupert Gould, so rare to

find in company with, and in harmony with, such a quality of imagination as was his.

When I saw him last, at the Business Efficiency Exhibition in 1947, he was a sick man; I think he knew he would never recover, but looking round the exhibition (he was thinking of writing a comparable work on the story of the adding machine) he remarked that the less time one had to live, the more one found to arouse one's curiosity. Rupert Gould was curious, not in the common but in the literal sense—he could not stop himself trying to work out the answer to anything that struck him as an oddity or enigma.

DUDLEY W. HOOPER, M.A., A.C.A.

LONDON
January 1949

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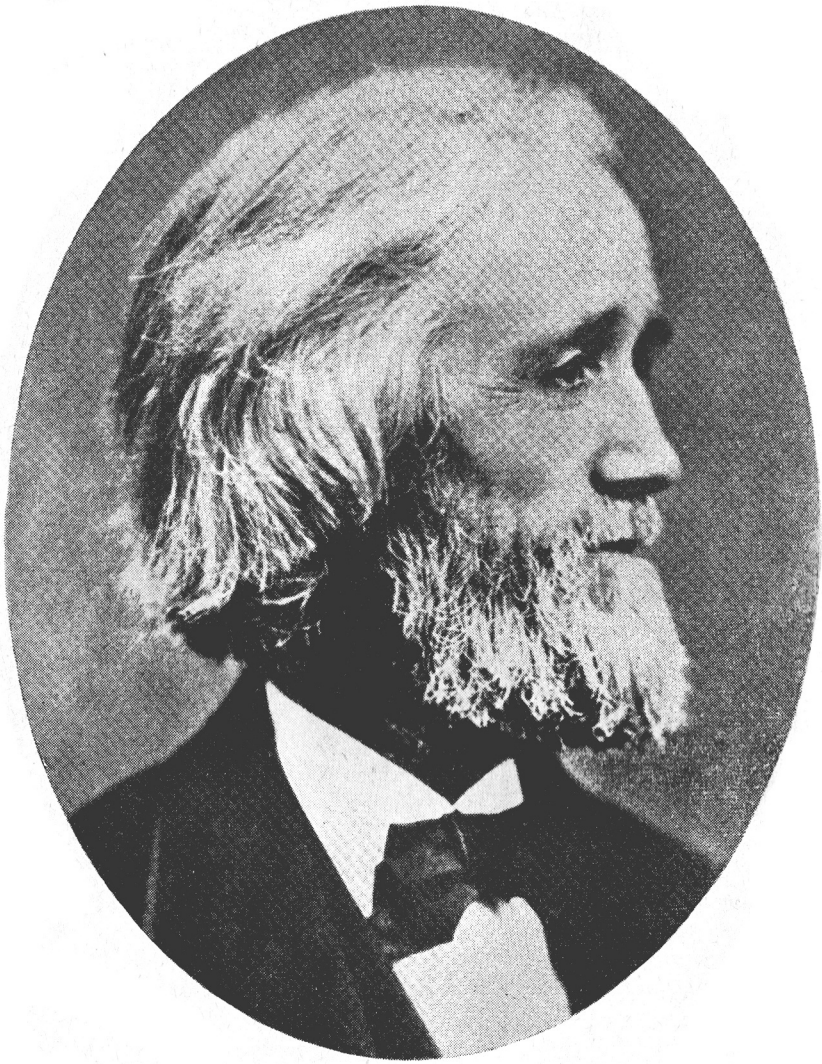
All the photographic illustrations of machines are of exhibits in the Science Museum, South Kensington, London, S.W.7., and are reproduced by permission —Crown Copyright Reserved.

The illustration on page 10 is taken from a photograph of Christopher Latham Sholes, in the possession of Messrs. Remington Rand Ltd., and is printed with their kind permission.

The drawing of Progin's Machine Kryptographique (page 14*) has been prepared by Crumwell Services Ltd. from information supplied by the author.*

Christopher Latham Sholes



'The Father of the Typewriter'

1. BEFORE 1840

(Henry Mill—Burt & Progin—'Block' and 'Bar' machines—the 'Typographer' —the 'Machine Kryptographique')

The modern typewriter numbers its users by millions; but I question whether many of them could give any clear account of its history. The majority, I fancy, would be inclined to surmise that it is an American invention of comparatively recent date. Not so. The first typewriter of which there is any record was invented by an Englishman, who took out a patent for it (No. 395 of 1714) in the days of good Queen Anne.

He was one Henry Mill, engineer to the New River Water Company; and his patent, issued on 7th January (O.S.), 1714, recounts that he has '. . . by his great study, paines and expense, lately invented and brought to perfection an artificial machine or method for the impressing or transcribing of letters singly or progressively one after another, as in writing, whereby all writings whatsoever may be engrossed on paper or parchment so neat and exact as not to be distinguished from print . . . the impression being deeper and more lasting than any other writing, and not to be erased or coun erfeited without manifest discovery'.

Unfortunately, that is absolutely all that we know, and are ever likely to know, of his invention. In Queen Anne's day, the Patent laws did not require that an inventor should, as the Scottish legal phrase has it, 'condescend to particulars'; he was under no obligation to put in a detailed specification and/or drawings of his invention—and, in Mill's case, no details, drawings, specimens or even contemporary mentions of his machine have survived. It may not have been a machine at all; it may have been a 'method' of producing the 'impression' by means of a loose set of bookbinder's types, or of stencil-plates; but the wording certainly suggests, if it does no more, that Mill had developed some form of writing machine.

Even so, this could only have been an isolated portent, appearing a century and a half ahead of its proper time. Before the era of machine-tools, it could never have held its own in competition with the pen. The three points in which the modern typewriter holds the advantage over its rival are (in ascending order of importance) legibility; the power of manifolding; and speed. In addition it is—it has to be—compact, robust, not easily deranged, and not exorbitantly dear. In Mill's day, and long after, there was no general demand for such a machine—and, if there had been, this could not have been met. Only in the middle of last century

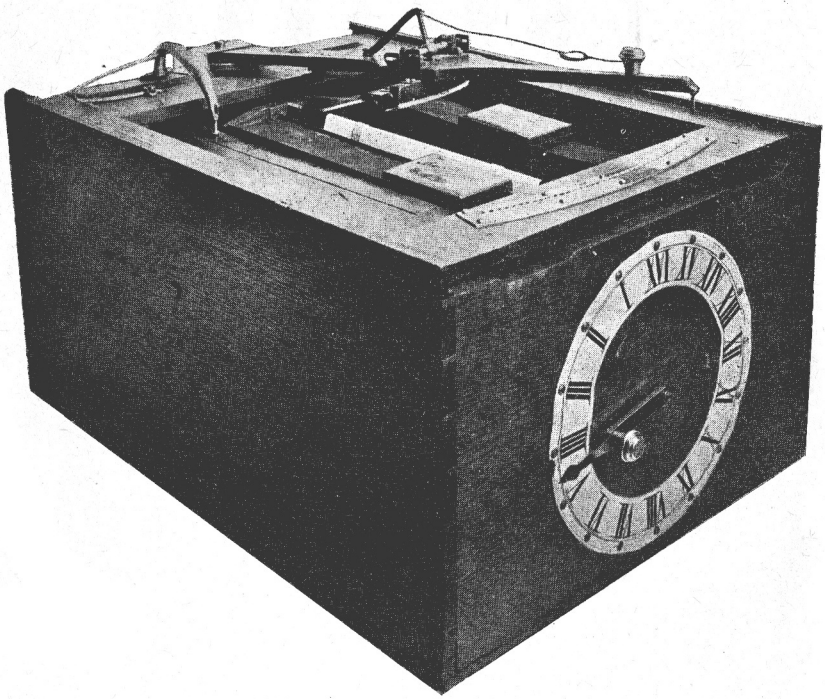


FIG. 1. *A replica of William Austin Burt's 'Typographer', patented in* 1829. *The original machine was destroyed in a fire at the U.S. Patent Office in* 1836. *This replica was contructed in* 1893 *from the original drawings.*

did the rapid improvement of transport and communications emphasise the necessity for some similar acceleration in business methods and office-work; while, at about the same period, the development of machine-tools and repetition-processes made it possible, for the first time, to produce piecemeal and to assemble in quantity complicated mechanisms which would give reliable service in the hands of an ordinary user, and which were comparatively cheap. It is at that epoch, naturally enough, that the modern form of typewriter, mass-produced in quantity at a cut price, makes its first appearance—although the preceding hundred years had witnessed a good deal of preparatory spade-work, and the production of many isolated specimens.

Reverting for a moment to the main problem which confronted the early inventors—how to write faster than the pen—what sort of standard had they in mind? What was the average speed of the pen in the hands of a trained and practiced secretary? Well, any one can test that experimentally. For example, I find that I can write a memorised passage legibly, in ink, at a little over forty words per minute; but my speed drops a good deal after a few minutes—or immediately, if I am writing from unfamiliar copy. No doubt considerably higher speeds have been reached and maintained by expert penmen—it is known that Napoleon's secretaries, Meneval and Bourrienne, were expected to write for hours, from his dictation, at ordinary talking speed—and yet to be legible, and to make no mistakes! But I question whether any ordinary clerk who ever lived could average fifty words per minute for an hour. At least, it is on record that the winner of a pen-

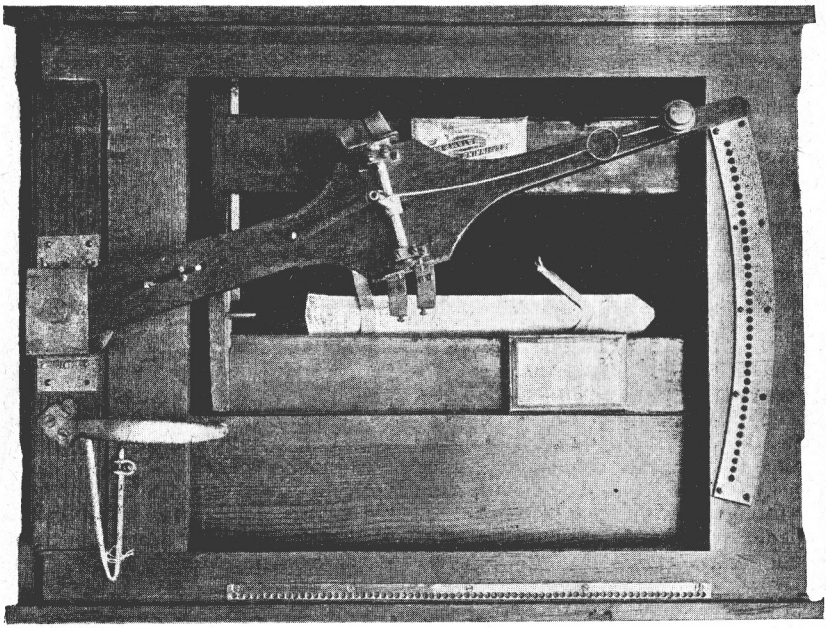


FIG. 2. *Burt's 'Typographer' viewed from above, showing the simple mechanism in more detail.*

speed contest held in 1853—a lady very appropriately named Wrighter—averaged no more than thirty. Compare this with the record established at a typewriter contest held in New York on 25th June, 1937, when Miss Stella Wilkins succeeded, under very onerous conditions—the competitors had to type continuously for one hour, from unfamiliar printed copy, with a deduction of ten words for each mistake—in averaging 128 words per minute. On the same occasion, Albert Tangora established a world's record (under the same conditions) of 141 (net) words per minute!

After Mill, the question of mechanical writing lay more or less dormant for many years. One reads of sporadic attempts at producing 'writing machines'—those, for instance, of Reipperg (1760), Jaquet & Pingeron (1780), and Conti (1823)—but none was of much practical value, and the scanty details available suggest that they were as much hand printing presses as typewriters. Here and later, let me note, the dates given are those at which any particular machine first attracted public attention—the date at which it was publicly exhibited and/or placed on the market. If the machine's date is 1874 or later, its origin is American unless otherwise stated.

In the first quarter of the nineteenth century occurred two events of fundamental importance in the history of typewriter mechanism. William Austin Burt of Detroit patented his 'Typographer' in 1829; Xavier Progin of Marseilles his 'Machine Kryptographique' in 1833. Every typewriter yet made or designed falls into one of two main classes—of which Burt's machine exemplifies one, and Progin's the other.

These two classes may be styled, respectively, the 'Block' and 'Bar' forms of typewriter. In the former, the types are either cast, or otherwise assembled, to form a single block,

which may be of several forms—a rectangular block, a straight bar, a segment of a circle, a disc, a cylinder, or even a sphere. To bring any selected type, therefore, to the printing-point, it is necessary to move the entire block. In machines of the 'bar' class, on the other hand, the types are mounted on movable bars, and any type can be brought to the printing-point without moving the remainder. The fact that some machines of the 'block' class employ more than one block, and that most machines of the 'bar' class mount two (and sometimes more) types on one bar, does not affect the general principle of this classification. In the 'block' class, perfect alignment of the successive impressions is much more easily obtained, and the machine can —though at a sacrifice of speed—be manufactured very cheaply; but the 'bar' class scores by the greatly reduced inertia of the moving parts, which makes for very rapid operation.

Burt's machine (specimens of whose writing still exist, although the machine itself was destroyed in a fire at the U.S. Patent Office, Washington, in 1836) was of the 'block' class. There is a replica, constructed (1893) from the original drawings, in the Science Museum.

The mechanism—almost entirely of wood—is housed in a rectangular wooden box some eighteen inches long and a foot square in section. The lid of this box is an open wooden frame, sliding lengthways in grooves, and carrying a long radial arm pivoted at one end and free to move both horizontally and vertically. The type-block (curved concentrically with the pivot) is mounted at about the centre of the arm, whose outer end carries a pointer moving over an indicator-plate. Moving the pointer

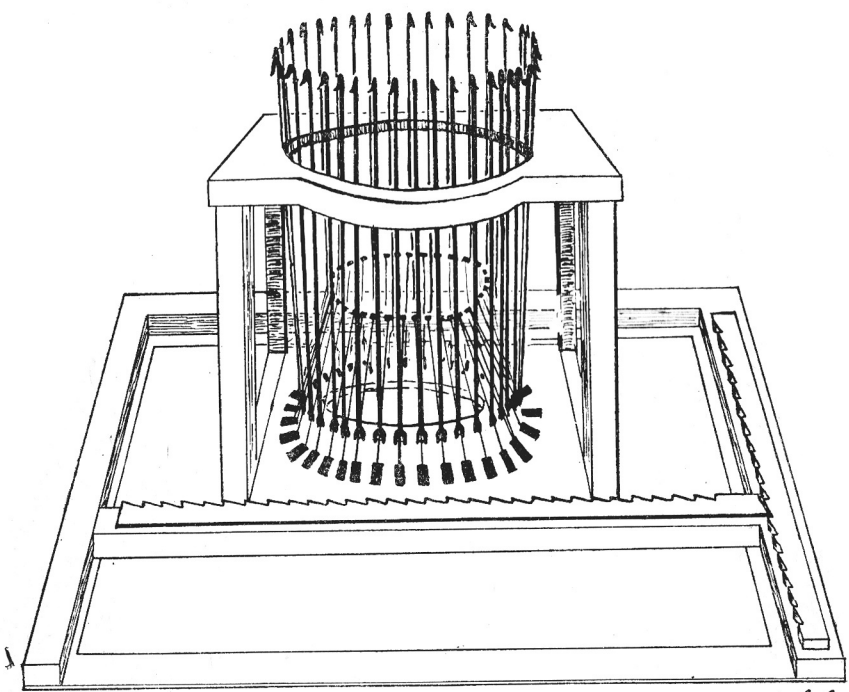


FIG. 3. *A sketch of Xavier Progin's 'Machine Kryptographique', illustrating the elementary type-bars, one for each character.*

to any one of the characters (capitals, lower-case letters, numerals and a few signs) on this plate brings the corresponding type to the printing-point: depressing the pointer then imprints this type on a band of paper running over a roller immediately below the arm. The latter is advanced one space, automatically, after each impression—but the line-spacing has to be effected by hand, for which purpose a handle and pointer, moving over a clock-dial indicator-plate, is provided at one end of the box. The types are inked from small inking-pads which have to be periodically re-inked by hand. The whole is what would nowadays be termed an 'index-machine'. It did quite creditable work, but was necessarily very slow in operation.

For all its jaw-breaking name, Progin's 'Machine Kryptographique' held the germ of better things than Burt's. As designed*, the whole machine moved bodily, as a modern book-typewriter does, over the surface of a stationary, horizontal sheet of paper. The types—capitals (except W), numerals (2 to 9), and three stops—were mounted at the upper ends of thirty-eight type-bars pivoted into bearings forming a circle from which the bars rose upwards and inwards, at an angle of about 45 degrees. The centre of the circle was the printing-point, and the selected type was brought to it by pressing down the hooked upper end of a stiff wire pivoted into the bar not far from its bearing. This circle of hooked ends constituted the 'key-board' of the machine. Two toothed racks provided for the machine's lateral motion after each impression, and for the line-spacing. Progin's design was incomplete in many details, but he seems to have been the first to devise the system of circularly-disposed type-bars, all converging to a common printing-point, which dominated typewriter construction until the very end of the nineteenth century.

* According to Martin (French edn.) Progin built one and tested it for a year before taking out his patent.

2. 1840 to 1850

(Charles Thurber—the 'Chirographer'—Machines for the Blind—Hughes, Foucault & Beach—Beginnings of the Commercial Typewriter—Wheatstone)

Some years after Burt and Progin, Charles Thurber, an American mechanician of repute, turned his attention to the subject. His first machine, patented in 1843, seems at first sight rather difficult to classify, as it had forty-eight type-bars, mounted vertically and independently in the circumference of a flat drum which could be rotated by hand, round a vertical axis, so as to bring any selected type-bar to the printing-point. The foot of the bar bore the type, and at the top was a mother-of-pearl button with the particular character engraved on it. Pressure on the button caused the type-bar to descend (locking the drum, temporarily, in exact register by means of a sliding key entering a fixed key-way) and the type to rub against an inking roller and then meet the paper. This was rolled around a horizontal cylinder (or, as it is called to-day, a 'platen') which was automatically advanced, by a form of escapement, between letters, and could be turned by hand to effect the line-spacing. As *all* the types had to be moved to bring any *one* to the printing-point, the machine, in spite of its type-bars, was really of the 'block' class; and it suffered from the defect common to many of them—that since two successive operations (first selection, then impression) are required to write each letter, the speed of writing is necessarily slow.

Two years later, Thurber patented a much more elaborate mechanism which, so far as I know, was and remains unique. He called it the 'Chirographer'. It did not *print* letters, but *wrote* them, with a pencil, on a vertical sheet of paper in full view of the operator. A long horizontal shaft, rotated by power, carried a series of cams, two for each character. One of each pair was a face-cam, causing the pencil to move horizontally—the other an edge-cam, which moved it vertically. Putting down a key clutched the corresponding pair of cams to the shaft for one complete turn, and caused the pencil to write the required character—after which, the paper was automatically moved to the left for a distance varying with the width of the character just written. The machine was, therefore, the first exponent of 'differential spacing'—of which more will be said later. So far as is known, only one 'Chirographer' was ever completed. Undoubtedly, it was a marvellously ingenious piece of mechanism—but at the same time it was far too bulky, complicated, and expensive to have the least chance of commercial success.

Machines for the use of the blind

At this epoch, although the rapid-writing, commercial typewriter was still unborn, considerable attention seems to have been given to producing machines writing in embossed characters, which a blind person could read by touch. Isolated

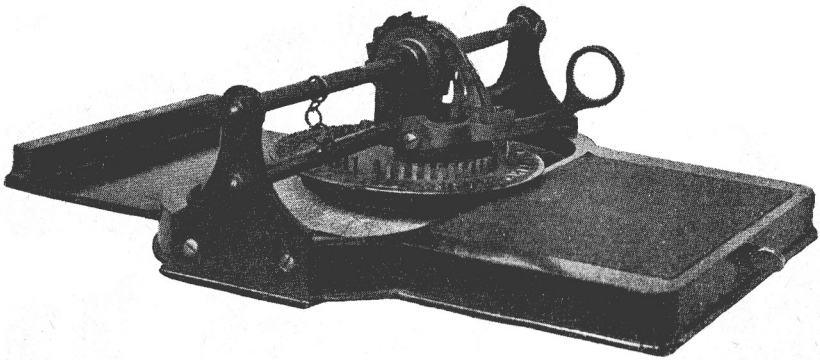


FIG. 4. *William Hughes' 'Typographer'* (1851), *a 'block' machine embossing characters for the blind.*

efforts in this direction had been made by Pingeron, a Frenchman who patented one as early as 1780, and by Turri, of Castelnuovo, who made another in 1808 for the blind Contessa C. F. da Fivizzono—but no details of either machine have survived. We are better informed, however, as to the work done by Littledale, of York (1844); by the blind Pierre Foucault, a teacher at the Paris Institute for the Blind, who produced his 'Raphigraphe' in 1849; and by William Hughes, Governor of the Manchester Blind Asylum, of whose machine (designed in 1851) there is a specimen in the Science Museum.

The Littledale and Hughes machines were of the 'block' class—simple, and slow to operate: but Foucault was more ambitious, and employed type-bars arranged in two or, in a later model, four fan-shaped segments mounted above the paper and converging to a common printing-point. His machine won him several gold medals, and came into moderately extended use; but its bulk alone—it had to be mounted on a low stool in front of a *standing* operator—debarred it from adaptation to ordinary uses. The same applies to the very ingenious machine evolved (1847-1856) by A. E. Beach, then editor of 'The Scientific American'. Beach used two complete circles of pivoted type-bars, respectively above and below the paper, and operated in pairs, by connecting-rods and bell-cranks, from a 3-bank keyboard. On a key being put down, the corresponding pair of bars converged, scissors-fashion, gripped the paper (a narrow tape, fed automatically) and embossed the required character. It was a very well-designed machine, and did good work—but, apart from being bulky and expensive, its mechanism precluded it from writing on an ordinary sheet of paper.

For completeness, the later history of the blind man's typewriter may be briefly sketched here. The development of machines, such as those described, writing embossed *letters*, was rendered superfluous by the rapid advance in popular favour of the Braille system, in which any character can be represented by an arrangement of six, or less, embossed *dots*. Early in the 'nineties Prof. Hall, of the Illinois Institution for the Blind, invented a very simple machine (it had only six keys and a space-key) which embossed the Braille dots on a sheet of paper; and this was followed in 1899 by the very similar Picht (German) Braille-writer. Later still came the Stainsby-Wayne (English) shorthand-typewriter, which writes Braille upon a continuous paper tape. A trained blind operator, equipped with a Stainsby-Wayne and an ordinary

typewriter, can take dictation, and subsequently type it out, fully as fast as any one possessing the use of his eyes—'. . . a Thing', as the Marquess of Worcester said long ago about his attempt at perpetual motion 'most Incredible, if not Seen'.

The beginnings of the commercial typewriter

Apart from work upon embossing machines, the middle decades of the nineteenth century witnessed the gradual evolution of a practical form of commercial typewriter—the 'Up-strike' pattern, in which a circle of type-bars strike upwards and inwards, converging to a common printing-point on the under-side of a horizontal platen. This culminated in the Sholes-Densmore machine of 1873 (afterwards the Remington No. 1) the first typewriter to be manufactured in considerable numbers, and to achieve definite commercial success.

Progress was, at the same time, made in other directions—but this can be dismissed with a brief preliminary summary. Pape, a Frenchman, produced a 24-key machine in which the operator could inspect his work by lifting the keyboard—not the platen. Two Germans, Rohlfs and Schmidt, invented in 1847 a form of 'block' machine in which the characters were embossed on a rotating prism. When the required one was brought to the printing-point, a hammer struck the paper from the back, and produced the imprint—a feature of many 'type-wheel' and 'typesleeve' machines. Oliver T. Eddy, of Baltimore, patented in 1850 what is undoubtedly the largest, clumsiest and most complicated machine of the 'block' class ever invented. It had, *inter alia*, 78 keys arranged in rows like a 4-manual organ, and weighed several

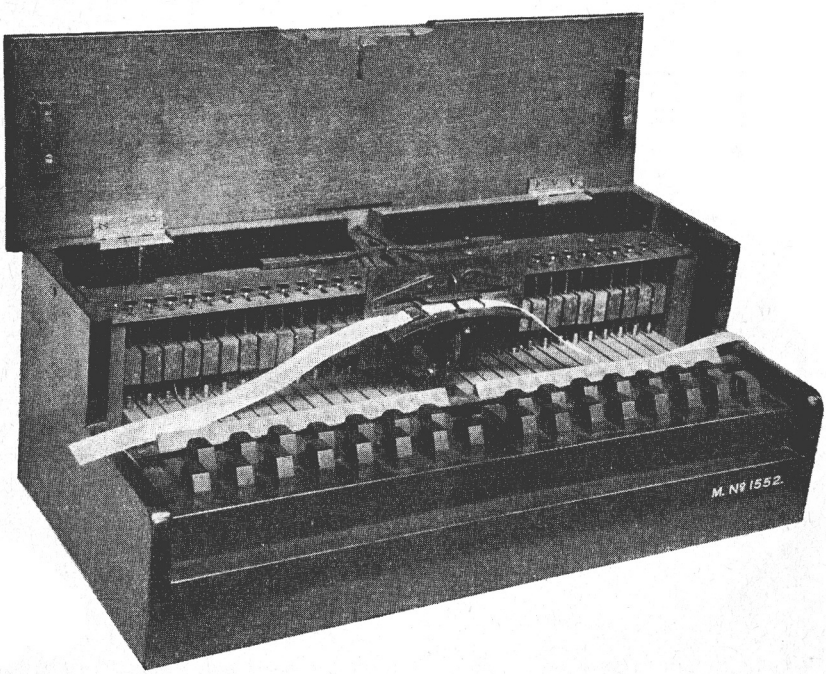


FIG. 5. *An early machine of Sir Charles Wheatstone's* (*c.* 1855), *a 'bar' machine designed for the rapid printing of telegrams on a paper ribbon.*

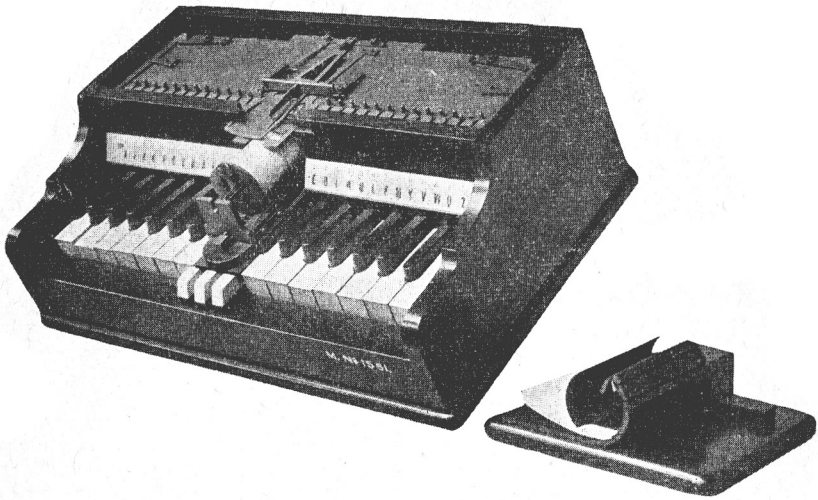


FIG. 6. *A later Wheatstone machine* (*c.* 1860), *writing on a cylindrical platen. The paper had to be specially folded before insertion, using the apparatus shown on the right.*

hundredweight. Another American, J. Jones, patented in 1852 a 'Mechanical Typographer' reminiscent of Thurber's first design but possessing, like his second, the feature of 'differential spacing'. Two others, Thomas (1854) and Cooper (1856) evolved 'block' machines of no great merit, while in England Sir Charles Wheatstone, one of the foremost electricians of his time, produced between 1855 and 1860, in conjunction with Herr Pickler of Budapest, no less than six typewriting machines, of which three are preserved in the Science Museum. The early models were designed for the rapid printing of telegrams, and wrote—like Beach's—on a narrow paper ribbon; but the final form had a cylindrical platen big enough to accommodate an ordinary sheet of paper. Like its forerunners, it was of the 'block' class, the types—capitals and lower-case letters—being soldered on to the teeth of two curved metal combs. The keyboard closely resembled that of a piano. On a key being depressed, the corresponding type was brought to the printing-point, and a hammer then struck down on it and produced the imprint. The types were inked by means of an ink-pad. It was a workable typewriter, but its 'touch' was very heavy. No attempt was made to place any of the Wheatstone machines on the market—in fact, for many years their existence was practically unknown to the general public.

3. 1850 to 1860

(Ravizza—Francis—Pratt's 'Pterotype')

The lack of public knowledge of early inventions, noted in connection with the productions of Sir Charles Wheatstone, applies with even greater force to the work of Guiseppe Ravizza (1811-1885) a lawyer of Novara, in Italy. In 1921, when a monograph written by Conte Emilio Budan on the subject of Ravizza's work was published at Venice, it is safe to say that very few persons then living had the slightest notion of the enormous amount of intelligent, persevering and badly-remunerated work done for the development of mechanical writing by this almost-forgotten Italian pioneer. Not only did he produce a whole series of workable and constantly-improving typewriters, but he also contrived to manufacture these, in small quantities and largely with his own hands, for sale to the public—a prospectus which he issued in 1856 announces that the price of his 'Cembalo-scrivano' is 300 lire.

He is believed to have begun work on the first form of his machine as long ago as 1837, but his principal patents date from 1856 and 1857. His machines were all of the 'Up-strike' (i.e. 'bar') class, the type-bars being arranged in a circle and striking upwards to a common printing-point. The paper was held in a flat wooden frame, not rolled around a platen. As in all machines of the kind, the writing was invisible while it was being executed—but in later models Ravizza arranged that the paper-frame could be thrown back on a hinge to disclose the writing. The first model wrote capitals only—later ones wrote lower-case letters also. The keys were oblong in shape, rather like dominoes, and the letters were not arranged alphabetically but in order of frequency. An escapement provided for the automatic advance of the paper-frame after each letter; while at the end of a line a signal was exhibited and the operator then returned the frame to the right by pulling a string. Ravizza experimented with both roller- and ribbon-inking, ultimately preferring the latter, and he used a guide to maintain the alignment of his types. In fact, he gradually made his machines very efficient examples of their particular kind. Unfortunately, he seems to have worked in almost complete ignorance of what other inventors and manufacturers were doing; and when he attempted, toward the close of his life (1883) to obtain a further patent for the improvements which he had gradually introduced into his machine since 1857, he must have been most disagreeably surprised to find that his final product bore an almost uncanny resemblance to the Remington No. 2 typewriter—whose mechanism was already covered, in all countries, by exhaustive patents of several years' standing, and which commanded a much more extensive market than he had ever been able to secure!

If Ravizza had cared to, he might, I think, have been able to get the

Rem[illegible] patents set aside in Ital[illegible]here else, on the ground of '[illegible]olic user'; but, without adeq[illegible]ancial backing—and he never seems to have had much of this—such action would have done him little or no good. He took his disappointment philosophically, and devoted the short remainder of his life to developing a typewriter capable of writing syllables at one impression (a machine of the kind was designed by one Flamm, a Frenchman, in 1863, and there have been other attempts since). Guiseppe Ravizza died in 1885, aged seventy-four.

As everyone knows, inventions and discoveries have a habit of being made in duplicate. Leaving out the vexed question of whether Newton or Leibnitz is responsible for the *notation* of the differential calculus (the *principle* is unquestionably Newton's discovery), it is enough to recall the independent calculation of Neptune's position by Adams in this country and by Le Verrier in France; the contemporary work of Wheatstone and of Morse (U.S.) in telegraphy; the simultaneous publication of Darwin's and Wallace's identical theories of natural selection; the absolutely synchronous applications of Graham Bell and Elisha Gray for patents in their newly-invented telephones; and the fact that two communications, one from Lockyer (England) and the other from Janssen (France), each describing the same novel method of seeing the solar prominences when the sun is not eclipsed, reached the Académie des Sciences, Paris, by the same post! Consequently, it is not at all surprising that in the same year in which Ravizza secured his second patent (1857) a very similar typewriter should have appeared, and been patented, on the other side of the Atlantic.

Its inventor was a New York physician, Dr. S. W. Francis. Like Ravizza's machine, it is of the 'Upstrike' form of the 'bar' class. The type-bars are not arranged in a complete circle but in an arc of some 220 degrees. The keys, thirty-nine in all (twenty-two white, seventeen black) are arranged piano-fashion, and the connection between key and type-bar is also of the piano-type; depressing a key throws the corresponding type-bar up to the printing-point, but does not hold it there—having made its imprint, it falls freely back to its original position, even though the key be still held down. This action, essential in a piano, is too complicated for a commercial typewriter, but it certainly reduces the chance of the type-bars clashing at or near the printing-point. It has been tried in one or two later machines; the 'English' (1890) for example, and the 'Stoewer' (1903).

Francis inked his types by means of an impregnated silk ribbon, while his platen was drawn along by means of a spring and controlled by an escapement. The platen was not a cylinder, but a narrow, flat bar mounted on a hinged frame which could easily be thrown back to let the operator see the writing, while a fixed pointer indicated where the next letter would come. Built, like Burt's 'Typographer', mainly of wood, the machine was somewhat bulky—but it was certainly efficient, being capable of a higher speed than the pen. It was never marketed in quantity, but a few were made and sold at $100 each.

A machine on very similar lines, except that it had a horizontal cylindrical platen (revolved slightly after each imprint, and shifted axially for line-spacing) and a 2-bank keyboard *à la* Beach, was devised by George House of Buffalo, N.Y., in 1865; and at about the same period an Austrian inventor, Peter Mitterhofer of Kufstein, produced two or three somewhat similar machines, one being designed to perforate characters on paper for the use of the blind.

In 1866 John Pratt, an American living in London, took out a British patent (No. 3163, 1st December, 1866) for a machine which he called a 'Pterotype' ('winged type'), and

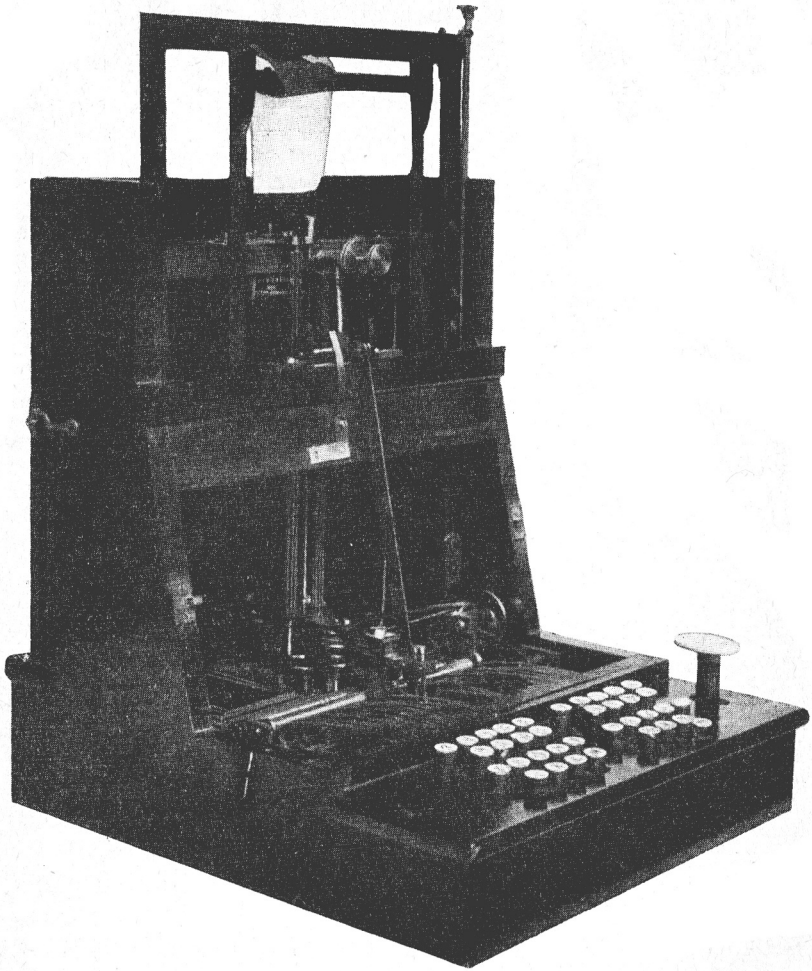


FIG. 7. *John Pratt's 'Pterotype'.—An improved model (about 1868) of his 1866 patent; a 'block' machine with separate key for each character.*

which represents an important step in the development of 'block' typewriters. As already noted, such are more or less bound to be slower in operation than 'bar' machines, since *all* of the types have to be moved in order to print *one*; but in those (such as Burt's 'Typographer') of earlier date than Pratt's, as well as in many 'index' machines of a later period, the operation is further retarded by having to be performed in two steps —the first being to bring the selected type to the printing-point, and the second to impress it on the paper. Pratt, in his patent, mounts his types on a rectangular plate, and provides a fixed keyboard with a separate key for each character. On pressing a key, the type-plate is brought to the required position, a hammer strikes the paper from the back and brings it against the type, and the paper is then shifted to make room for the next letter—all in one motion. A machine of this type,

exhibited to the Society of Arts in the following year, has now disappeared—but the Science Museum has a specimen of a later and much improved form, praiseworthy both in design and construction. Its date is uncertain, but it was probably made in 1868.

The type-block is a small cylinder (½ in. diameter) carrying three horizontal rows of twelve type each, and mounted on a vertical axis, along which it can be slid up or down so as to bring any of the three rows to the height of the printing-point. The axis, under the influence of a coiled spring, is always tending to turn, but is normally held by a very ingenious, though complicated, escapement. Immediately behind the cylinder is the paper, held in a vertical frame capable of being moved both horizontally and vertically: and behind the paper is a small, ivory-faced hammer which strikes the paper against the selected type—in other words, the face of the hammer, when in action comes to (and, in fact, constitutes) the printing-point. Arranged horizontally at the base of the machine, in front, are thirty-six keys (one for each character printed) arranged in four rows; and on the right is a single much larger key.

On putting down a key, several things happen, more or less simultaneously. For clearness, let us divide the descent of the key into three stages.

Stage 1. The type-cylinder is, if necessary, raised or lowered until the right row of type is in line with the printing-point. The hammer is raised to half-cock. The paper-frame moves one space to the left.

Stage 2. The type-cylinder spindle is released, and flies round until it meets a stop. The required type is now at the printing-point. The hammer has by now risen to full-cock.

Stage 3. The hammer is released, flies forward under the influence of its spring, makes the imprint, and falls back. The key is released by the operator and rises flush with its fellows.

The whole operation sounds—and was—rather complicated; still the machine could be worked quite fast. In fact, its speed was only limited by the need for making sure that a depressed key had fully returned to its normal position before the next was put down—neglect of this meant jamming the elaborate escapement which controlled the type-cylinder. A curious feature of the machine was, that it had no specific 'space key', as in a modern typewriter; any one of the thirty-six keys could be used as a space key, since if slightly depressed it allowed the paper-frame to shift one space sideways without releasing anything else. At the end of the line, a hefty bang on the large key at the right-hand side of the keyboard—

(*a*) Traversed the paper-frame to the extreme right.

(*b*) Raised it one line-space.

(*c*) Rewound the spring impelling the type-cylinder.

(*d*) Rewound the spring impelling the paper-frame to the left. (The hammer-spring, it will be remembered, was recocked every time a key was put down.)

There was no inking device. Before starting, the paper to be written on was covered with a carbon sheet, and that again with transparent transfer-paper, on which the operator could see the writing appear as it progressed—except the last few letters, which were masked by the type-cylinder. A similar plan was used in the Hansen (next described) and in a few later machines, such as the 'Westphalia'.

This very ingenious and perfectly workable machine was the parent, mechanically speaking, of many successful 'type-wheel' and 'type-sleeve' machines of later date. Unfortunately, it was never marketed; but it attracted a good deal of attention, and was described and illustrated in several journals. As will be seen later, the publicity given to it had a considerable indirect influence on the production of the first really successful typewriter.

4. 1860 to 1870

(Hansen's 'Schriebkugel'—The work of Christopher Latham Sholes—Soulé & Glidden—James Densmore)

In 1872 there appeared the second or, if we include a handful of Francis machines the third typewriter—Ravizza's being the first—to be manufactured for sale. It was invented by Pastor Malling Hansen, of the Royal Institute for the Deaf and Dumb, Copenhagen. He called it a 'Schriebkugel' (Writing Ball), and it strongly resembled a hemispherical pincushion into which had been stuck a large number of button-headed hat-pins. Fifty-two plungers, each with a single type at its lower end, were mounted in radial slots cut in a brass half-ball, and converged to a common printing-point below it. As in Pratt's machine, a sheet of carbon-paper obviated the need for inking the types.

In theory, a machine of this 'radial-plunger' type should be capable of very high speed, since the travel of the bars is exceedingly short and direct—but in the Hansen the correct key took a good deal of finding, and the touch (owing to the primitive traversing and line-spacing arrangements) was so heavy that in a later model this 'donkey-work' was done by a train of clockwork controlled by an electric circuit. A good many of the machines were made—some were still to be seen in use, in various old business houses on the Continent, not so many years ago.

The only two later machines on the lines of the Hansen have followed it into oblivion. One was the Schade (1896) which had a full 'pincushion' keyboard — eighty-four keys, as against the fifty-two (capitals and signs only) of the Hansen. Like Progin's machine long before, it was designed to move across a stationary sheet of paper, and could therefore be used as a book-typewriter. Faber's 'Elektrograph' of 1900 differed from both its predecessors, in that its plungers were electrically operated from a fixed keyboard (eight banks of ten keys). The paper was mounted on a slightly-inclined table travelling on rails; and above this, supported by four pillars, was a fixed polyhedral casing which housed the plungers, solenoids and batteries.

The work of C. L. Sholes

To return to the main line of the typewriter's descent, we must recross the Atlantic. Here, for the first time, we encounter the engaging personality of Christopher Latham Sholes, generally and justly acclaimed as 'Father of the Typewriter'.

Sholes (1819-1890) was a highly intelligent man of fine character who ran a creditable career while burdened with a double handicap—frail health and excessive diffidence. Born in Columbia County, Pennsylvania, of old New England stock, he was apprenticed to the printing trade, afterwards turning to journalism—chiefly as editor of various local papers. His integrity of character brought him, not very willingly, two terms as State Senator, 1848-49 and 1856-57. In 1860 he removed to Milwaukee, where he stayed for a good many years, first as postmaster and afterwards as commissioner of public works and collector of customs. For a long while, also, he edited the Milwaukee 'Daily Sentinel' and 'News'. It is entirely typical of Sholes' temperament that while he made a point of publishing, in any paper which he controlled, all adverse criticisms—and some of them were very bitter—passed upon him by his political opponents, he always struck out any remarks praising either himself or his doings!

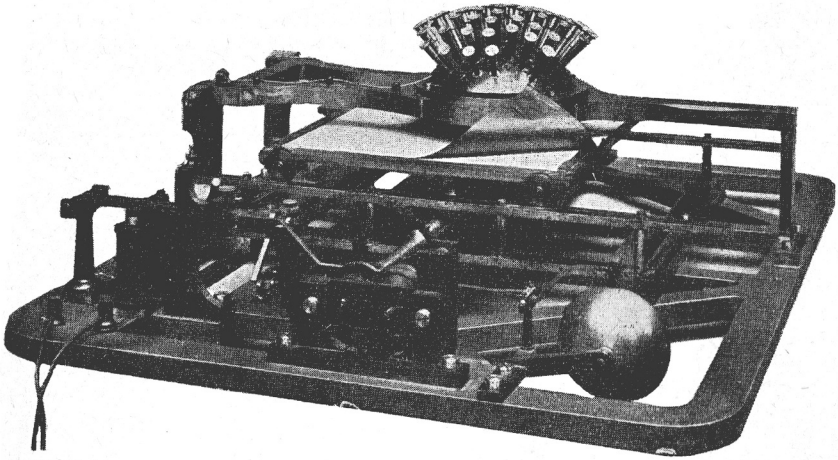


FIG. 8. *Pastor Malling Hansen's 'Schriebkugel' (or 'Writing Ball') of* 1872, *showing the carbon sheet used in place of inking the type-faces, and the electrical controls for the clockwork-operated line-spacing and traversing.*

When he began his work on typewriters in 1867, he had already devised a method of addressing copies of newspapers to subscribers by printing their names in the margin and also—in association with another printer, S. W. Soulé—a machine for numbering the pages of blank books. A business associate, Carlos Glidden, suggested that he might modify the machine to write letters as well as figures, and afterwards showed Sholes a copy of the 'Scientific American' (of 6th July, 1867), containing a description of Pratt's 'Pterotype', and also an editorial extolling the wide field of usefulness which awaited such a machine. Ultimately Sholes, Glidden and Soulé joined forces to produce a mechanical writing machine, Glidden finding the funds for experimental work, while Sholes and Soulé—greatly assisted by Matthias Schwalbach, a mechanic in Kleinstuber's machine-shop, where the earliest machines were made—devoted themselves to the mechanism.

The first model, completed in the autumn of 1867, was a very crude affair, suggesting a cross between the Francis and House machines. It was of the 'Up-strike' 'bar' class, with a circle of converging type-bars (Soulé's contribution) inked through a ribbon, and a horizontal cylindrical platen—moved for spacing by a *weight*, not a spring. The keyboard was of piano pattern, and situated at one end, i.e. at right angles to the axis of the platen.

For all its crudity, the machine would write clearly and rapidly—and the partners used it to produce circulars, which they despatched to anyone whom they thought might be interested. One of these circulars, sent to James Densmore of Meadville, Pa., scored a bull's-eye.

Densmore was the exact antithesis of Sholes—a bluff, burly, thick-skinned man full of energy and self-confidence. He at once took a share in the enterprise—and, at his advent, Glidden and Soulé quietly dropped out, leaving Sholes and Densmore to carry on together. Densmore showed himself a second Matthew Boulton. As Boulton had done with Watt, he left all mechanical questions to his inventive but despondent partner, while helping him financially and encouraging him, both verbally and by letter, with kindly commonsense and confident prophecies of ultimate success. For instance, Sholes sent several success-

ive models of his machine, each embodying some slight improvement, to a Washington stenographer, J. O. Clephane, for practical test. As fast as they arrived, Clephane 'gave them the works' and reported in every case that they would not stand up to prolonged usage. At last, Sholes declared, *more Adolphi*, that his patience was exhausted; but Densmore intervened to point out that such results, however exasperating they might seem, were a blessing in disguise, and that unless a machine could be produced which would stand up to hard work in the hands of an unsparing operator, their enterprise was foredoomed to failure. Obviously, it was better to discover all the main defects themselves, than to have these pointed out by angry purchasers.

Sholes admitted the force of this argument, and persevered until, early in 1873, the last of some thirty experimental machines seemed good enough to be ready for marketing. I defer description, since it mainly differed from the commercial product only in using weights, instead of springs, to effect the carriage movement and line-spacing—a feature which was discarded before production started.

While tentatively searching for manufacturing facilities, Densmore —very fortunately for himself— consulted a former business associate: a born salesman, glib and tactful, with a golden tongue that never tired, and a manner calculated to inspire the most hardened sceptic with instant confidence in any proposition he might advance. His name —let us have it in full—was George Washington Newton Yost; a name long remembered in the typewriter trade. On Yost's advice, Densmore and himself took the final model to the famous Remington Armoury at Ilion, N.Y.: and while Philo Remington, the president of the company, betrayed little enthusiasm, the machine's obvious potentialities impressed others of his staff (particularly W. K. Jenne, then running the sewing-machine department) so much that the firm finally undertook to manufacture one thousand machines for Densmore and Yost to market. The contract was signed on 1st March, 1873; and, after several interim improvements had been made in the mechanism first inspected by Remingtons, manufacture began that autumn. By the spring of 1874, the first (and only) model of the 'Sholes, Glidden & Soulé Typewriter' (this name was stencilled, in gilt letters, on the front of each machine) was on the market.

Why that particular title? Well, I imagine that Sholes retained the names of his former partners in order to avoid legal difficulties. Years earlier, the joint work of the three, so far as it went, had been covered by two U.S. Patents (79,365 of 23rd June, 1868, and 79,868 of 14th July, 1868), granted to all three by name. It is, however, only doing bare justice to refer to the 1874 machine as the 'Sholes-Densmore'.

As for the word 'typewriter', it is rather surprising that hardly any inventor seems to have thought of it earlier, preferring such ugly neologisms as 'Chirographer', 'Machine Kryptographique', 'Pterotype', or— most popular of all—'Mechanical Typographer'. One is reminded of the still extant *official* name for a taxi-cab—a 'Mechanical Clarence'. I have only come across one earlier use of the term 'typewriter'. In 1845 Mr. Prentice, editor of the *Louisville Journal*, writing to a friend, remarks:

> 'A friend of mine, a very ingenious man (Dr. Leavitt, of Kentucky) has just invented a typewriter. I thought you would like to see a specimen of the first work it has done.'

5. The 1870's

(The 'Sholes-Densmore'—Layout of the Keyboard—'Remington' No. 1 and No. 2)

The Sholes-Densmore, of which a few specimens have fortunately survived —I know of five in this country, including two in my own collection and the one at the Science Museum—is a somewhat bulky and heavy machine, but well-made and quite efficient. It is a 'bar' typewriter of the 'up-stroke' pattern.

Forty-four type-bars, each bearing one character at the inner end, are pivoted into short bearings arranged tangentially to a common circle. When at rest, these bars hang downwards in a 'type-basket' below the platen, forming an inverted runca ed cone. Below this are the key-levers (of the 2nd order), formed of long, flat strips of wood lying side-by-side and pivoting in a horizontal bar at the back of the base. Each strip is cut to some one of four standard lengths, and their outer ends carry the keys, which are consequently ranged into four rows, or 'banks', of eleven (capital letters, numerals 2 to 9, and ten signs). Each key-lever is connected by a wire to the outer end of its corresponding type-bar, and on depressing any key the required type is brought upwards and inwards to a common printing-point at the bottom of the platen, and strikes the paper through an inked ribbon (about an inch wide) which runs horizontally, just below the platen, between two spools housed underneath the flat top-plate of the machine. The ribbon is moved on automatically after each letter, but its motion has to be reversed, when necessary, by hand. (Remington's introduced the first automatic ribbon-reverse in 1896).

The platen (rubber-covered) is of large diameter—it had to be, since the types were flat-faced (in modern machines, their faces are curved to the same radius as the platen). It is mounted on bearings on a traversing carriage, supported at the front by a small wheel and in rear by a guide-bar. This bar forms a hinge, allowing the carriage to be lifted and the writing inspected. The paper is held to the platen by rubber bands.

A cord, kept in tension by a coiled spring in a drum, tends constantly to pull the carriage to the left—but this motion is normally prevented by an escapement engaging the teeth of a rack forming part of the carriage. The escapement is connected, by wires, with a horizontal wooden bar running just below the key-levers (known as the 'universal bar'—it has been a standard typewriter feature ever since). When a key is put down, this bar is immediately depressed, and the escapement shifts its engagement to the next tooth of the rack, allowing the carriage (and with it the paper) to move one letter-space to the left.

On the right side of the machine is a long lever, pivoted in rear, inclining upwards, and terminating in a handle. At the end of a line, the operator depresses .h s lever, and a

FIG. 9. *The 'Sholes-Densmore' Typewriter of* 1874 (*also known as the 'Sholes & Glidden' or 'Sholes, Glidden & Soulé'*). *This was the immediate forerunner of the original Remington.*

cord, connected with it via a double radius pulley, returns the carriage to the right, at the same time revolving the platen through 1, 2 or 3 line-spaces as desired. Although soon discarded in favour of a simple hook on the carriage itself, this form of carriage-return appears in one or two later machines, such as the 'Granville Automatic' (1896) and the German 'Ideal' (1900).

Such is the Sholes-Densmore, the first typewriter to be manufactured in quantity, by mass production, for sale to the public. Mechanically, it is the first concrete statement of the general principles which have been accepted ever since as governing the main trend of typewriter design. On that ground alone, it is difficult to praise its inventor, Sholes, too highly. Yet the *originality* of his work is, and always will be, a debatable point. There is hardly a single feature of the Sholes-Densmore which cannot be found in the work of some earlier inventor; and while it is not to be supposed that Sholes knew, or could have known, the details of all such efforts, it is equally unlikely that he could have been entirely ignorant of their existence.

At any rate the machine had one entirely original and very suprising feature—the arrangement of the keys. Here it is—and most typists, I think, will recognise it.

2 3 4 5 6 7 8 9 - ,
Q W E R T Y U O I P
£ A S D F G H J K L M
& Z C X V B N ? . '

Here in this pioneer machine of 1874 we have, in essentials, the standard keyboard used to-day all over the world. It owes this widespread acceptance simply to the fact

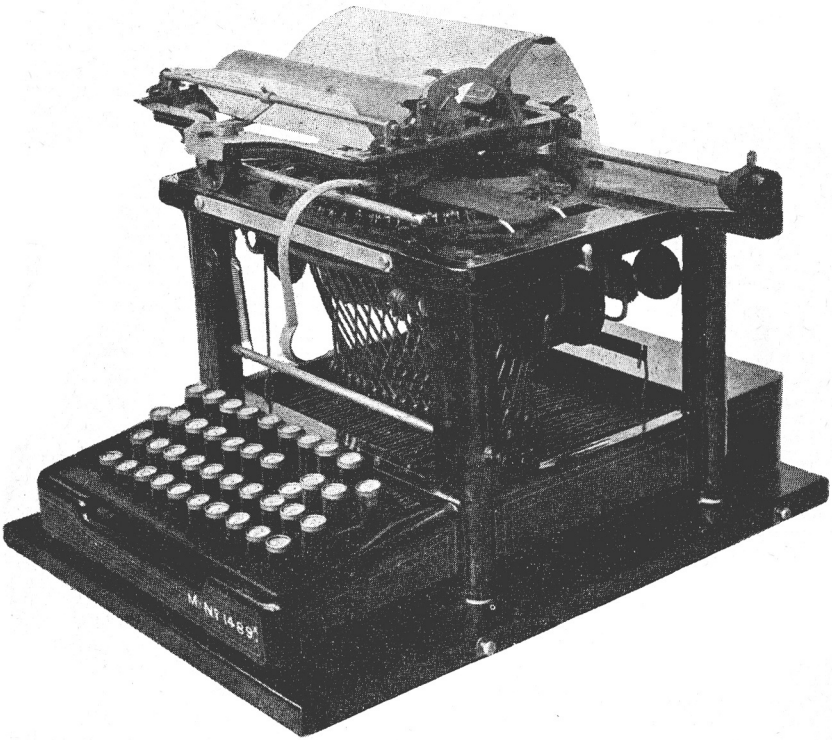


FIG. 10. *Remington No.* 2 (1878), *which set the fashion in typewriters until early in the present century. It embodied a great step forward—the introduction of the shift mechanism, upper and lower case characters being mounted on the same type-bar.*

that it was first in the field—not at all to its own merits. For it has many obvious defects, e.g. the letter 'e'—most used of all—should have been placed for first-finger operation; and 'q' and 'u', which are invariably associated (except at the end of a few proper names like 'Dumaresq', and when transliterating from Arabic) ought to have been placed side by side, not separated by two-thirds the width of the keyboard. In point of fact, the Sholes keyboard has no scientific basis at all—for example, it is certainly not founded (as has sometimes been asserted) on the arrangement of a printer's case, or upon any count of letter frequencies. It originated simply in the fact that Sholes found his type-bars apt to clash and jam near the printing-point. In consequence, he so disposed the bars that letters which commonly occurred together were on bars as far removed as possible—and he also provided a slotted metal comb to guide each bar and so obviate, to a certain extent, any backlash in its pivots.

Incidentally, several attempts have been made to introduce better keyboards, e.g. the Crandall and Fitch machines, the earlier Hammond and Blickensderfer models, the well-studied 'Common-sense' keyboard designed by the late Mr. L. R. Richards of Bristol, and the recent 'Dvorak'. But the standard keyboard has gained far too long a start for such efforts to have any real hope of success.

The Sholes-Densmore, in its original form, had only a short career. The stock went off very slowly: to manufacture the machine proved much easier than to sell it, or to train

its operators—the selling agencies had to establish *free schools* for this purpose. In 1875 Sholes and Densmore sold their rights, on a royalty basis, to Remington's; and Sholes disposed of his royalties to Densmore for a lump payment of $12,000. Densmore's royalties made him, in time, a wealthy man—but his self-effacing partner never made another cent out of the machine he had done so much to perfect. He continued, however, to devise improvements in it, for his own satisfaction, at intervals; and he is believed to have had a considerable share in the 'Sholes Visible' typewriter which came on the market long after his death.

Bedridden for several years, Sholes died (of pthisis) in Milwaukee on 17th February, 1890, aged sixty-two. A monument to his memory was unveiled in Sholes Park, Ilion, on 12th September, 1923—the fiftieth anniversary of the actual day on which the Remington firm put the Sholes-Densmore machine into production.

The Remington typewriter

For the next few years, the story of the typewriter is the story of the Remington machine—so much so, that its makers originally called it simply 'The Typewriter'. Remington No. 1 differed in a few respects from the Sholes-Densmore—a dust-cover was provided for the platen, as well as the keyboard, and the 'coffee-grinder' handle for returning the carriage to the right was discarded in favour of, first, a foot-treadle (soon abandoned) and then a simple hook-shaped handle on the carriage, which could be used both for returning it and for throwing it back to view the writing. At the same time, the 'comb' for guiding the type-bars was scrapped, the type-bar bearings thus becoming entirely responsible for maintaining the alignment of the letters.

Remington 2 which appeared in 1878, was a great step forward, and set the fashion in typewriters for many years—until the rapid development of 'front-strike', visible writing, machines early in the present century. A simple plan, devised by Byron A. Brooks, who afterwards designed the Brooks typewriter, doubled the Remingtons capacity, enabling it to write both capitals and lower-case letters, as well as a considerably greater number of signs. Each type-bar carried two types, cast as one block and mounted at right angles to the writing-line. The machine thus had two printing-points, and the platen was moved bodily from one of these to the other by means of a shift-key. In this manner, seventy-eight characters could be written by the Remington 2's thirty-nine keys.

6. The 1880's

(Index machines—the 'Columbia' and 'Mignon'—Type wheel and sleeve machines—Crandall and Hammond)

The Advent of Competition

By the early 'eighties, the considerable and growing commercial success of the Remington typewriter had brought into view the first pioneers of a large horde of competitors, all eager to 'muscle in' and grab a share of the 'easy money'. In modern salesman's jargon, the U.S.A.—and, to a less extent, Europe—had become 'typewriter conscious'. The commercial public, as a whole, wanted typewriters, and was prepared to pay for them—and a perfect spate of new designs rapidly flooded the market.

A detailed account of these newcomers would fill a large book, and a collection of them a good-sized museum. As a private collector (I think, the only one in this country) I have got together some seventy specimens: the Science Museum has about ninety; and an American enthusiast, Mr. C. P. Dietz, has accumulated, I believe, between 350 and 400. But, if one takes into account different models of the same make, a *complete* collection of all the different typewriters ever made would certainly number considerably more than a thousand exhibits.

From the mechanical standpoint, luckily, they fall into a few well-marked classes, as follows:

'Block' machines

(*a*) Rudimentary typewriters of the 'Burt' pattern, generally known as 'Index' machines. Slow and cheap.

(*b*) 'Type-wheel' and 'type-sleeve' machines.

'Bar' machines

(*c*) Machines on Remington 2 lines, (non-visible, single shift).

(*d*) 'Full keyboard' machines, (no shift).

(*e*) 'Semi-visible' machines.

(*f*) 'Front-stroke' machines ('Underwood' type). 'Direct view' machines.

(*g*) Odd machines, of all kinds.

Here are a few notes on these classes, in that order. Class *f*, incidentally, embraces the vast majority of the typewriters now on the market—with one or two honourable exceptions, all machines in the other classes may be regarded as obsolete, and no longer made.

Index machines

During 1880-1900, at least thirty different machines of this kind saw the light—their object, apparently, being to produce (slowly and clumsily) correspondence which looked as if it had been written on an ordinary typewriter costing £25-£30, although actually turned out on a machine priced at £5 or less. As Ruskin once wrote (I quote from memory) 'There is hardly any article of commerce which someone else cannot make a little worse, and sell a little cheaper; and those who consider price only are that man's lawful prey'. Some were frankly made to sell; some were mere toys; a few, like the 'Columbia' (1884), 'Merritt' (1889), and 'People's' (1893) were creditable productions, well made and capable of good work, if slow. One of the cleverest came later, the 'Mignon' (1903). In this, the type-block was of 'sleeve' form (a long, thin cylinder) and the 'index' a thin steel pointer, universally jointed and movable over a plate, engraved with the characters, about the size of a post card. This constitu ed, in effect, the keyboard, and bringing the pointer to a selected character automatically rotated the type-sleeve, and also shifted it axially, until the corresponding type was at the printing-point—after which a tap on the printing-key made the impression by swinging the type-sleeve down to the

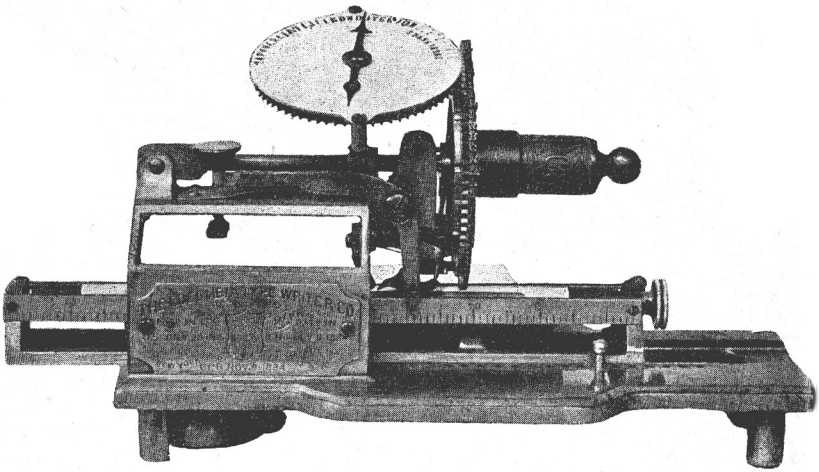


FIG. 11. *The 'Columbia'* (1884-86), *an 'index' machine.*

paper. The 'Mignon' was fairly fast in action—for an index machine—and could be supplied with several type-sleeves (and their corresponding keyboards) so that languages such as German, Russian and Greek could be written on the same machine. I am not certain whether it is still manufactured—but, in any event, the demand for all such machines is small, and not likely to increase.

'Type-wheel' and 'Type-sleeve' machines

As we have seen, Pratt produced a workable type-wheel machine in 1866. In 1879 L. S. Crandall marketed the first model of his type-sleeve machine. In appearance and operation, the type-sleeve itself resembled that of the 'Mignon' just described—but the machine had independent keys for the various characters, and the putting down of a key first selected the required type and then brought it to the paper—all in one motion.

Pratt applied to the U.S. Patent Office in 1880 for a patent on an improved form of his machine, but found himself, much to his surprise, 'in interference' with Crandall, and also with another U.S. inventor, J. B. Hammond, whose type-wheel machine, although the subject of much experimental work, had not yet seen the light. Ultimately Pratt, in return for a royalty, abandoned the field in Hammond's favour. I imagine that he was in a position to dictate the terms of the bargain, for his machine was covered by a U.S. Patent (No. 81,000 of 1868) and the first model of the Hammond, which appeared in 1884, embodied several of its devices. However, the royalty payment no doubt enabled Hammond to use, or to add, these with impunity.

The Hammond types were mounted, in three rows, on the rim of a sector (embracing some 140 degrees, and made in two separable halves) mounted on a vertical axis. This was swung to and fro, raised and lowered, by the action of the keys alone, no clockwork being used. As in Pratt's machine, a hammer, cocked and released by the keys, made the imprint by striking the paper against the type. Inking was effected by a narrow ribbon. The keyboard was of piano pattern with the keys (two banks) arranged in the arc of a circle, convex to the operator. There was no real platen—only a strip of leather. On starting a new sheet, this was first 'backed' into a cylindrical container between the keyboard and the type-wheel, and

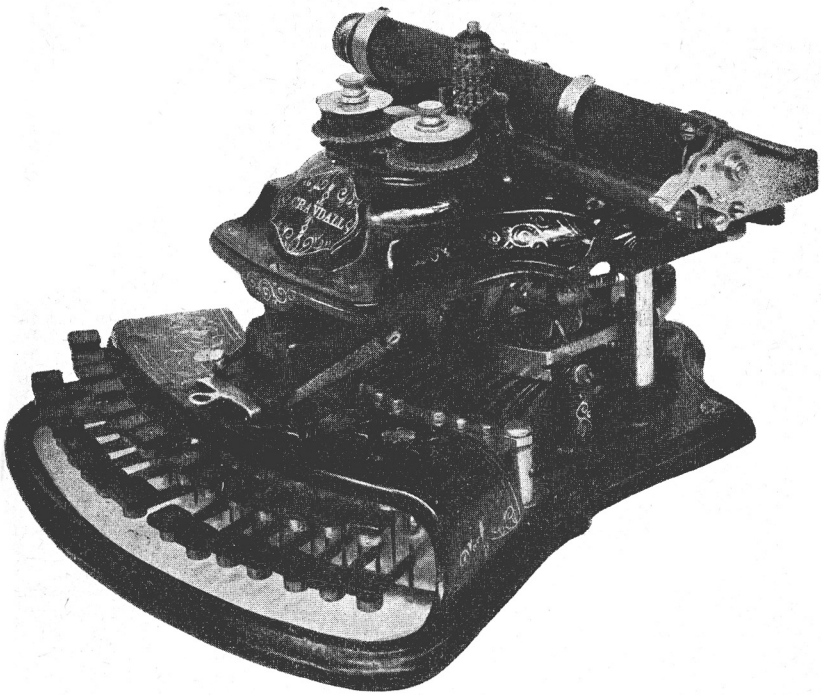


FIG. 12. *L. S. Crandall's No. 3, produced in 1893, a type-sleeve machine with keyboard.*

then fed upwards by a system of feed-rollers, its upper edge supported by an inclined, folding wire frame. All but the last line written was visible.

Later models of the Hammond—which was, until recently, the last surviving representative of its class—exhibited several changes. The piano keys went first—then the peculiar keyboard-plan. This met with little favour—only one other machine, the German 'Polygraph' (1903), would fit it—and operators who had learned on the Hammond found difficulty in working any other make. Instead, the makers adopted the standard-pattern keyboard with a *double* shift, and three banks of keys only. A special key was also provided which temporarily depressed the ribbon and allowed the line in progress to be inspected. Finally, the type-sector became a complete type-wheel, carrying two complete sets of different types (e.g. roman and italic) either of which could be brought into use by un-keying the wheel and turning it half-round.

I have given details of the Hammond, as the most representative specimen of its class—the remainder need only brief mention. Crandall marketed several different models at intervals—he was one of the tiny band of professional typewriter designers which includes such names as C. Spiro, F. X. Wagner, W. P. Kidder and R. W. Uhlig—the last credited with more than fifty separate designs. The 'Munson' of 1890 (afterwards the 'Chicago') was an excellent machine with a horizontal type-sleeve and hammer-impression; and the 'Blickensderfer' (1893), whose formidable name was generally and mercifully abbreviated to 'Blick', achieved great popularity. In this machine the impression was

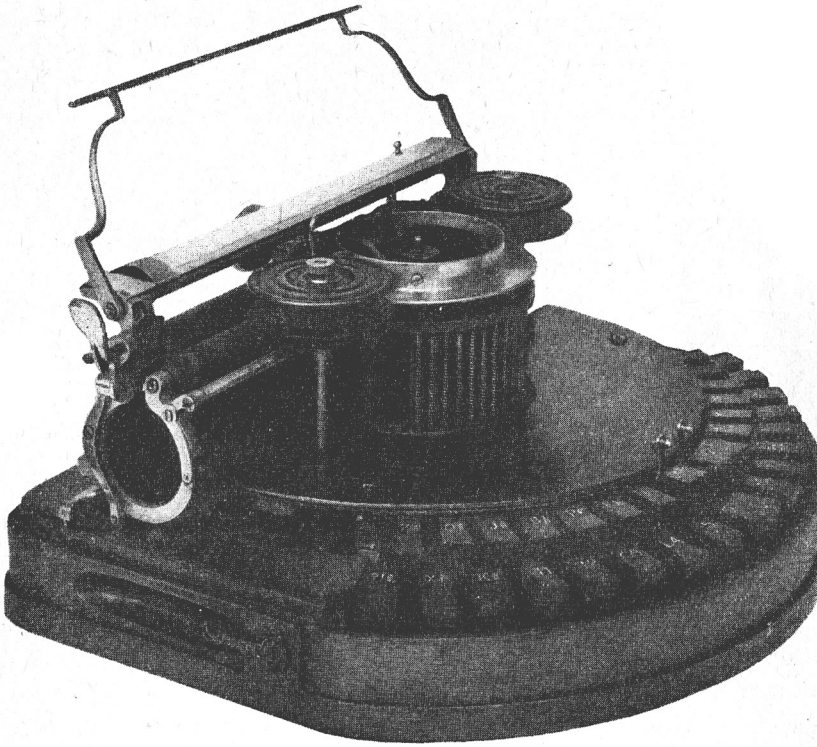


FIG. 13. *J. B. Hammond's 'Ideal'* (1884), *a type-wheel machine embodying many features evolved by John Pratt in later models of his 'Pterotype'* (FIG. 7.)

made by the type-wheel itself, striking an inking-roller *en route* to the paper. Mention should also be made of the several models devised by Hidalgo Moya, who was afterwards responsible for the 'Imperial'; and, finally, of one of the smallest and cleverest type-wheel machines ever made—the 'Lambert' (1896). The idea behind this was revolutionary. It had, practically, only one moving part. Type-wheel and keyboard were in one piece—a tilting disc with the characters engraved on embossed studs all round it and mounted on a ball-and-socket pivot, extended downwards in the form of a truncated cone terminating, below the pivot, in three concentric rings of types (eighty-four in all) and a series of guiding-notches. To write any character with the Lambert, you simply pressed the corresponding button on the disc—this at once tilted, and brought the type—inked from a pad—to the printing-point. The pressure on the button continuing, the pivot (mounted on a spring-controlled plunger) sank slightly, allowing the type to imprint the paper.

The Lambert only weighed 8½ lb., and could be worked by a skilled operator at 100 words a minute. Its sole defect—an insuperable one, unfortunately—was its peculiar keyboard. The better you could work a Lambert, the more surely you were handicapped in using any other machine.

7. The 1880's (continued)

(The full keyboard—Yost's 'Caligraph'—the 'Bar-Lock'—semi-visible machines and the development of touch-typing)

Machines on Remington No. 2 Lines

These, in general, followed closely on the lines of their prototype—in fact the 'Manhattan' (1898) was admittedly a copy of it, using such of the Remington patents as were no longer in force. The same applies to the 'English Remington' a very inferior and short-lived production. The 'Densmore' (1891), sponsored by Sholes' erstwhile partner, was noteworthy for having ball-bearings throughout, and the 'Fox' (1890), had a two-speed escapement, allowing of very rapid operation—in the hands of an expert. The 'Remington-Sholes' (1896), afterwards the 'Fay-Sholes' (1902) was the subject of prolonged litigation as to the right of its joint producers (sons, respectively, of Philo Remington and C. L. Sholes) to use their own names. Ultimately, they won this (in the U.S. Supreme Court) but did not exercise it.

'Full keyboard' machines

In 1883 Yost, having severed his connection with Remingtons, brought out the 'Caligraph' typewriter, designed by F. X. Wagner—who was gravely, though not fatally, handicapped by having to evade the Remington patents. This he accomplished in various ways, e.g. by pivoting the key-levers at the front of the base, instead of the rear, and making them of the third order. Still, his design had considerable independent merits, and it was the first to have a 'full keyboard'—one with a separate key for every character (capitals, lower-case letters, figures and signs) which it wrote. As originally arranged, however—in six banks of thirteen keys—the lower-case types occupied the centre, while the capitals were grouped higgledy-piggledy at either side. In consequence, to use the 'Caligraph' at any speed it was necessary to memorise the position of every one of the seventy-eight keys. The 'Bar-Lock' (1887) adopted the common-sense plan of a keyboard with the lower-case letters occupying the three lowest banks and the capitals duplicating their arrangement (the standard QWERTYUIOP one) on the uppermost three; a plan which other machines, including the 'Caligraph' itself, were not long in following. The 'Bar-Lock', incidentally, was also the first machine fitted with a back-space key.

In general, the remainder of the class—such as the Peerless (1891), Jewett (1892), Hartford (1894) and 'New Century' (an improved 'Caligraph'—1900)—present few features of interest, but there are two outstanding exceptions—the 'Smith-Premier', and the 'Yost'.

The 'Smith-Premier' (1888), de-

FIG. 14. *The 'Bar-Lock' (1887), a full-keyboard machine, with a back-space key, the first machine to incorporate this. (The illustration is of Model No. 7.)*

signed by Alexander T. Brown, was planned on very solid and ingenious lines. Alignment—the weak point of the Remington 2—was secured by cranking the type-bar in such a way as to allow the use of much longer bearings. The connection between each key and its type-bar was made by couple-levers mounted on a rocking-shaft, so that a perfectly uniform 'touch' was secured, whatever the position of the key on the board, without having recourse to the 'sub-levers' used for the same purpose in most other machines. It is typical of Brown's thoroughness that he installed a large, permanent, circular brush (which could be rotated by a detachable crank-handle) in the heart of the machine for the purpose of rapidly and effectively cleaning the type.

The Yost (1890)—a very neat, compact machine, almost totally enclosed—also presented several new departures. It discarded the usual inking ribbon in favour of an ink-saturated pad, in which the faces of the types normally rested. The type-bars were quite loosely pivoted, and consisted of a set of jointed links which, on the depression of a key, withdrew the type from the pad, tilted its face upwards, and thrust it unerringly into the aperture of an exceedingly rigid central guide. Each type-face was exactly the same size, and had bevelled edges fitting the bevelled lip of the guide. The pad-inking and forced alignment of the Yost enabled it to turn out writing which fully justified the company's slogan of 'The Machine for Beautiful Work'.

Semi-visible machines

Neither index, type-wheel nor, in the long run, full keyboard machines succeeded in shaking the hold which the Remington 2 (and its followers) had on the market. In this connection it is interesting to recall the result of a speed contest held at Cincinnati (25th July, 1888) between Lous Traub, the leading 'Caligraph' exponent, and Frank E. McGurrin, a Remington 2 user who had taught himself what is called nowadays the 'touch' system of typing. The pair had to type for forty-five minutes

from dictation, and then for the same period from printed copy—unfamiliar matter being used in each case.

McGurrin won both events decisively. The most striking feature of his performance was that his speed increased by three words per minute when typing from copy, while Traub's fell off by twelve. The reason is not far to seek—Traub had to memorise a few words of text and then go to the keyboard, while McGurrin, like a skilled pianist, kept his eyes fixed on the copy, writing by touch and never even glancing at the keys.

To an operator like McGurrin, the fact that he could not inspect what he was writing without throwing the carriage back was a matter of no importance; but to the ordinary typewriter user it was an annoying and persistent defect in an otherwise valuable office appliance. And so we find, running all through the history of the commercial typewriter, an insistent demand for visible writing—a demand which has ultimately swept into limbo all the highly developed 'blind' (i.e. non-visible writing) machines of the 'nineties.

In one or two experimental 'blind' machines of byegone days, prisms were used to render the writing visible, and also to invert it (for, if the operator could have viewed this *through* the platen, directly, it would appear upside-down). But such methods were foredoomed to failure, being both complicated and inefficient; and inventors in general turned their attention to the problem of writing either on the top or the front of the platen, instead of at the bottom.

In this connection we need only deal with machines of the 'bar' class. In many 'block' machines, from Pratt's onwards, the writing has been visible except where masked by the type-wheel or type-sleeve; but none has been completely freed from this defect except (as in the Hammond) by making the operator work an additional key—no great advance over throwing back the carriage of a 'blind' machine—and, as already explained, 'block' machines tend to be slow; while speed is a *sine qua non* to the modern typewriter.

Omitting for a moment the almost-unknown Canadian 'Horton' machine (1883), the first 'bar' typewriter with visible writing was the 'Fitch' (1886), in which the type-bars stood behind the platen, and struck downwards and forwards on to its top. With them so disposed, the line being written was perfectly visible—but, in order to keep the paper clear of the keyboard and the type-bars, its lower portion had to be housed, *a la* Hammond, in a cylindrical container in front of the platen, and its upper in another behind; so that while the operator could see what he was writing, he could not see the lines already written without feeding the sheet back. This defect, amongst others, made the Fitch's life a short one; and it also proved fatal to the only three others of the class—the Brooks (1887), Waverley (1889) and the 'North' (1892)—the two last being of English design and manufacture. Incidentally, the Brooks incorporated an escapement which allowed the space after a word to be made simultaneously with the last letter. It has been estimated that this device gives a gain of some 20 per cent. in speed; but it is only to be found in the Blick No. 1, the Crown (1887—the first and only typewriter with a built-in word-counter), the Brooks and the Waverley. The last-named machine is also noteworthy for its peculiar shift device—by which a standard keyboard of thirty-eight keys controlled seventy-six type-bars—and for its provision of 'differential spacing'.

8. The Turn of the Century

(Differential spacing—Writing on top of the platen—Maskelyne, Williams, Fitch and Oliver—'Thrust' and front-stroke machines—Daugherty, Underwood and Remington No. 10)

Differential Spacing

In theory, every typewriter's escapement ought to afford 'differential spacing', i.e. it should, before the impact of any particular type, let the platen move sideways a space proportionate to the width of that type. The writing would then be almost a facsimile of print. Such cannot be said of the work turned out on the modern typewriter, whose escapement impartially allots the standard tenth of an inch to a full-stop and to a capital 'W'. Names, for example, such as 'William Williamson' and 'Woolloomoolloo' (an Australian bay) occupy (the type-size being the same) some 30 per cent. more space when typed than when printed; so do words like 'illimitable'.

Yet only a few typewriters have ever been designed to give differential spacing, and none has survived. Here, so far as I know, is a complete list:

American: Thurber's 'Chirographer' (1845).
Jones (1852).
Crandall (1879).
Columbia (1882).
Megagraph (n. d.).

Note: The early Fitch had *partial* differential spacing, allotting more space to upper-case letters.

English: Daw and Tait (1884).
Maskelyne (1889).
Waverley (1895).

The Maskelyne—invented by that master mechanician J. N. Maskelyne, founder of 'Maskelyne's Mysteries'—was the most complete exponent of differential spacing ever produced. In effect, Maskelyne's escapement (controlled by *four* universal bars instead of the usual *one*) divided the uniform space-width of a normal typewriter into four equal portions, and allotted these as follows: 1 to a diphthong, such as æ, œ; 2 to the narrow letters (i, l); 3 to medium sized letters such as a, n, s; and 4 to the wide letters (m, w). The numerals and signs were spaced in a similar manner (except in the third, and last, model marketed, termed the 'Victoria'). When the Maskelyne was worked at a moderate speed, and the types were quite clean, it produced work which, in point of appearance, was a long way ahead of anything done before or since; but if worked fast, or not kept right up to concert pitch, it promptly jammed—so did its successor, the somewhat similar 'Waverley' (which provided for only three degrees of spacing). Typewriting is, I fear, committed in perpetuity to uniform spacing; our eyes have got accustomed to it, and it makes for simplicity and efficiency.

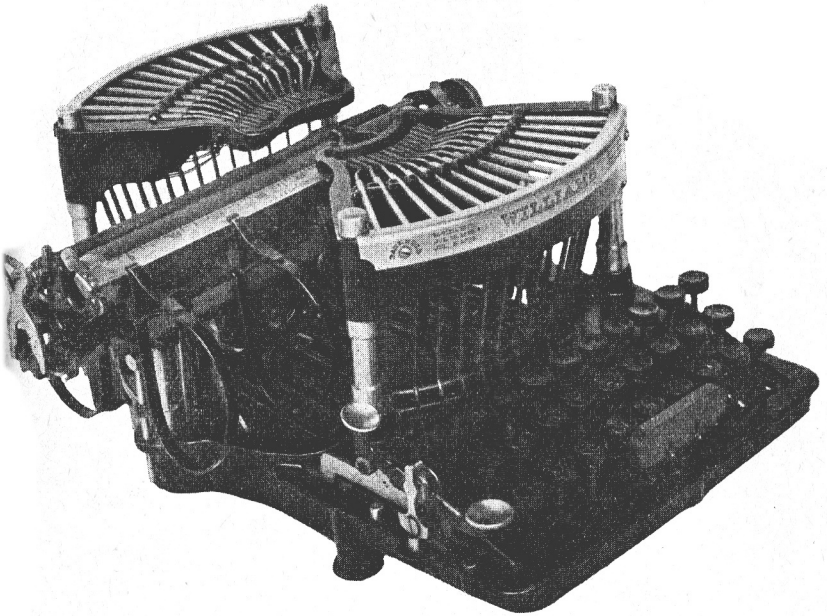


FIG. 15. *The Williams* (*c.* 1890), *which obtained greater visibility by the arrangement of the type-bars in two fans, striking down on top of the platen from front and back respectively.*

The Maskelyne, also, embodied a different method for writing on top of the platen. Its type-bars were arranged in a horizontal fan, with the types (three to a bar) converging, and resting in an ink-pad. On pressing a key, the corresponding bar—controlled by two links like those of a parallel ruler—rose, moved forward, and brought the type down at the printing-point on top of the platen. The same method was used in the once-popular Williams machine (1887), which avoided the excessive sideways motion of the Maskelyne's outer type-bars by arranging its own in two fans, one in front of the platen and one behind it. As in the 'Fitch' and its cogeners, the paper had to be rolled into two containers below the type-bars, so that only the line being written was really visible.

In another 'top-strike' machine, the 'Oliver' (1894) which, like the Williams, held its ground for many years, most of the work already done on the sheet was visible, but only the middle of the line then being written—two banks of type-bars, shaped like an inverted 'U' and of graduated sizes, straddled the platen and struck downwards and inwards to its top. Another plan, used in a number of machines such as the 'Bar-Lock' (1887), 'Franklin' (1891), 'Salter' (1892) and 'Imperial' (1907) arranged the type-bars erect, types uppermost, in front of the platen, forming a curved fence over which the operator had to crane his neck in order to see the writing-line. In view of this defect such machines, like most of the foregoing, are best described as semi-visible.

Thrust Machines

As already remarked, an alternative plan of obtaining visible writing was to make the types strike at or near the front of the platen. In the 'Rapid' (1890), a crude

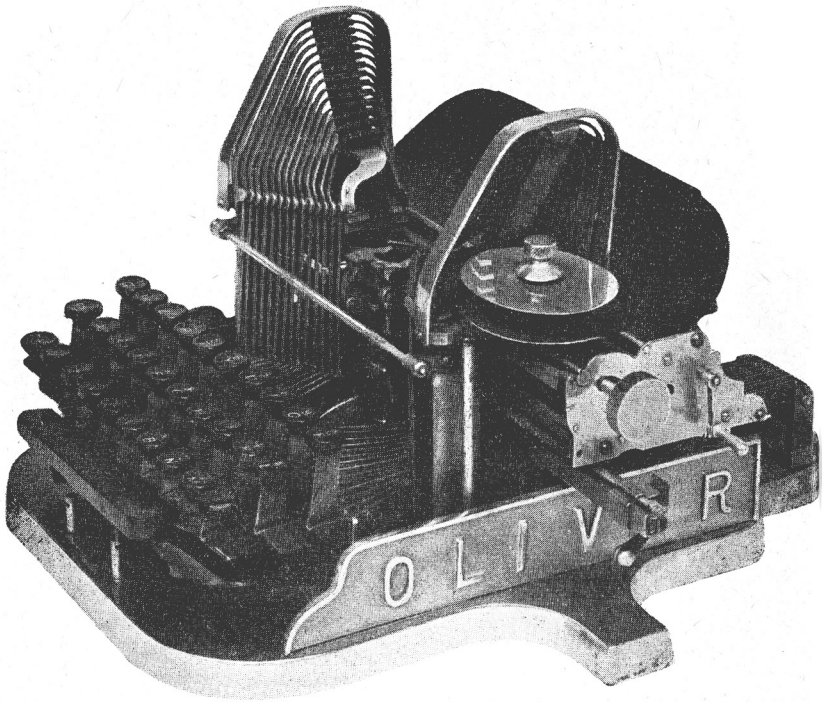


FIG. 16. *Oliver No. 1 (1894), giving greater visibility. This arrangement was still in use on some models of Oliver machines until 1946.*

machine writing capitals only, this was done by thrusting the type-bars forwards along converging horizontal guides. The same basic idea was carried out, on much more workmanlike lines, in the Canadian 'Empire' (1892), designed by W. P. Kidder, which only went off the market a few years ago; and the 'Ford' (1895) and 'Granville Automatic' (1896—an improved form of the 'Rapid') embodied the same principle. But while the whole work of such machines was visible, their speed, on account of the friction in the guides and the very small clearance, near the printing-point, between advancing and retiring bars, left something to be desired.

The 'Front-Stroke' machines

In the same year (1890) as the first 'thrust' machine there appeared the first typewriter of the modern 'front-stroke' type—the 'Daugherty' machine.

The basic idea is to be found in two almost simultaneous U.S. patents, secured three years earlier: Prouty & Hynes, No. 389,854 (5th January, 1887) and A. Grundy, No. 404,833 (18th January, 1887). In both of these, the type-bars lie horizontally, type upwards, in a sector below and in front of the platen, and strike upwards and inwards to its front. The two designs—neither of which was ever marketed—only differ in minor details: Prouty provided a four-bank keyboard with single-shift, and actuated his type-bars by push-links; Grundy used bell-cranks, and a three-bank keyboard with double-shift. Neither machine would have afforded *perfectly* visible writing, since the letters near the

FIG. 17. *Underwood No. 1 (1897), one of the earliest fully visible machines, which set the fashion in general design for the machine of to-day.*

printing-point were obscured by a wide, vertical inking-ribbon in the Prouty, and by a large inking-roller in the Grundy.

On the other hand the 'Daugherty' —which, there is little reason to doubt was conceived independently by its inventor, James D. Daugherty, a stenographer, as early as 1885, or two years before the Prouty and Grundy patents—interposed no obstruction of any kind between the operator's eyes and his work. The inking problem was solved, as it still is, by using a narrow (half-inch) ribbon which was lifted to the printing-point at the moment of impact and then dropped again; but while modern machines use a 'ribbon vibrator', sliding vertically in guides, for this purpose, Daugherty's ribbon-guide was pivoted horizontally, and normally lay back, away from the paper, at a slight angle to the vertical. It was carried forward, and the ribbon with it, by the impact of the type —afterwards falling back to disclose the writing.

The 'Daugherty' — afterwards known as the 'Pittsburg' and, still later, as the 'Reliance'—had the standard, one-shift keyboard, the change of case being effected very simply by rocking the type-basket, mounted in trunnions for this purpose. The type-basket could be removed, bodily, for cleaning; and other parts were also made readily demountable. To a modern eye, the machine's lines are graceful, if unusual; but the typewriter users of 1890 jibbed at its unfamiliar aspect. They said that its 'innards' were almost indecently exposed—and some complained that the sight of the dancing type-bars (invisible, of

course, in the 'blind' machines) distracted their attention and led to mistakes!

For this reason, and because of better marketing arrangements, the 'Underwood' (1898), invented by F. X. Wagner (designer, previously, of the 'Caligraph'), met with a much warmer reception and soon established itself firmly. More than that, it set a standard to which other makers, of much longer standing, found themselves obliged to conform—it is not unfair to describe the vast majority of office typewriters, to-day, as being, generically, of the Underwood type. Two of the best-known makes—Remington and Smith-Premier—took the decisive step in the autumn of 1908, when they produced their first 'visible' models. The resemblance of the Remington No. 10 to the Underwood was quite marked; but the Smith-Premier design (also No. 10 model) was a mechanical *tour de force*—the only front-stroke machine ever sent out with a full keyboard. To get sufficient length for the bearings, two type-sectors, superimposed, were fitted, the lower type-bars passing through the spaces between the upper. All the type-bars were mounted on ball-bearings. It was marketed for some years, but eventually gave place to a single-shift model.

The advent of the Underwood practically ends the story of the ordinary office typewriter, for it has undergone little change since it was first introduced, while its best-known rivals—Remington, Royal and L. C. Smith in this country; Bar-Lock and Imperial in this country; Japy in France; Continental and Mercedes in Germany—are now all planned on very similar lines. All are front-stroke machines with standard keyboards and single shift—the main point on which they are not yet unanimous is whether the shift should be effected by moving the platen (as in the Remington 2 of long ago and ever since) or, as in the 'Daugherty', by moving the type-basket. There are pros and cons; but it is worth noting that Tangora's record of 141 net words per minute was made on a 'Royal', which shifts the type-basket.

Direct View machines

No operator of ordinary build can look straight at the front of the platen; he looks down on it at an angle of about 45 degrees. Then why not incline the type-bar sector upwards at that angle, so as to put the writing-line midway between the top and front of the platen, and hence at right-angles to the line of sight? Well, this has often been done—it was done as long ago as 1883 in the Horton (Canadian) machine which, but for covering the centre of the sheet with a wide vertical ribbon terminating in a huge spool, would have afforded perfectly visible writing. Later machines of this type include the German 'Ideal' (1900) and the 'Norica' (1907), the short-lived 'Triumph Visible' of the same year, and the last models of the original 'Bar-Lock' (1912) and 'Salter' (1913) machines. The plan has not yet ousted the front-stroke principle in office typewriters, but it is coming into extensive use in portables.

9. Conclusion

(Some 'freak' typewriters—the 'Sholes Visible'—the 'Duplex'—To-day, and To-morrow)

Freak Typewriters

So far, this has largely been a chronicle of successful endeavour; but brief mention ought to be made of some few of the very many clever—often, too clever—typewriters which have perished in their infancy, or were even still-born. Take, for example, the 'Sholes Visible' (1900) (also known as the 'Meiselbach' and the 'Bonita Ball-Bearing') believed to embody C. L. Sholes' final conception of what a typewriter should be, but posthumously improved and marketed by his son Louis. At first sight, it seems unworkable, for the type-bars, leaning back at about 45 degrees from the vertical, were arranged in two parallel files, at right angles to the platen—the bars in each file lying one on top of the other, so that each type-face almost touched the back of the bar in front of it. There was, however, a narrow space between the two files of bars, and on depressing a key the corresponding bar first moved slightly sideways into the 'runway' and then struck forwards and upwards to the printing-point. The action was direct and powerful, but each bar had to come right home, or nearly so, before the next could begin its stroke—which hardly made for speed. In a later model, an attempt was made to eliminate this 'clashing' by widening the runway, so that the bars could move both forwards and upwards, simultaneously, with a slightly diagonal stroke.

Donnelly's 'Crown' typewriter (1887) was another very interesting failure (commercially). A circle of type-bars was housed in an inclined drum above the platen, its top constituting the keyboard, and the centre of its base the printing-point. The type-bars, which could be revolved around their own axes, carried a triangular prism, with a type on each face, at the upper end, and a bevel pinion at the lower. A large internally-toothed wheel engaged with all the pinions; and, by pressing either of the two shift-keys, the type-bars were rotated one-third of a turn, and the types thereby shifted. The machine embodied a word-counter, worked from the shift-key.

The German 'Kanzler' machine (1901—sold here as the 'Heraldic') was a 'thrust' machine with single-shift and forty-four keys, but only eleven type-bars, each bar carrying eight characters. The 'Century' (1900) patented by E. B. Hess, who afterwards designed the very successful 'Royal' typewriter, went one better, its nine type-bars carrying nine types each. The escapement allowed of more than one bar being put down at a time, so that syllables and short words could be written at a single stroke.

The 'Duplex' (1895) was also designed to write two letters simultaneously, and so get increased speed. It was a 'blind' machine with, apparently, a full circle of 'upstrike' type-bars—but actually this was composed of two semi-circles struck from centres one type-space apart. Each semi-circle was actuated from one half of the keyboard (100 characters), the left half containing two complete alphabets (capitals and lower-case) and the right another lower-case alphabet and the figures and signs. The machine had a limited success for a short time—but its effective operation proved too strenuous for the average typist. The same defect applied, with even greater force, to the German 'Bracklesberg' machine, with 132 keys, writing three characters simultaneously.

A simpler plan for getting enhanced speed was used in the 'Bennington' (1903), which was afterwards improved and reissued as the 'Xcel' (1922). An additional bank of keys below a standard four-bank keyboard controlled a series of type-bars carrying 'logotypes'—short words, such as 'be', 'is', 'and', 'not', &c., cast as single types. The idea is attractive, but with such abnormally wide types no type-guide can be used at the printing-point, and the risk of clashing bars is increased.

Yet another plan was tried in the 'Whyte' (1903—English), 'Hanson-Lee' (1905) and 'Nickerson' (1907) machines. These had a platen, of comparatively large diameter, mounted *vertically*. The writing-line ran across, not along, the platen—which rotated space by space, as the writing proceeded. At the end of a line, touching a special key raised the platen one line-space, at the same time allowing it to turn on further until the left-hand end of the next line came round to the printing-point. Time was undoubtedly saved—but so long as the sheet was on the platen half of it was necessarily invisible to the operator.

In fact, the diversity of bygone typewriters is almost endless. Some have been pneumatically operated such as the 'Pneumatic' (1894—English) and the later Austrian 'Soblik' which, incidentally, possessed the curious property of being able to write any word in which no letter was repeated, and each occurred later in the alphabet than its predecessor—such a word, for instance, as 'almost', or 'chintz'—by putting down *all* the required keys simultaneously. The French 'Virotyp' (1914) was not much bigger than a packet of cigarettes, while McCann's giant 'Megagraph' was 6 ft. by 5 ft. 10 in. by 3 ft. 4 in. and weighed 400 lb. It was fitted with differential spacing and designed to write newspaper posters. There have been some, like the 'Improved Crandall' (1895) and 'Jackson' (1898) which used type-bars but printed with a hammer—and mechanical marvels such as Maskelyne's last model in which the type-bars under compulsion of a most elaborate linkage executed a complete somersault on their way to the paper. But, one and all, they are gone from among us—and it seems improbable that we shall look upon their like again. *Où sont les neiges d'antan?*

To-day and to-morrow

In fact, the development of the ordinary form of typewriter, whether for office or personal use, seems to be approaching finality—or, at least stagnation. The delightful variety of last century's machines has given place to a small number of makes hardly differing in aspect or mechanism. In speed and convenience they leave very little to be desired—any further developments will probably be directed, as they are present, to the reduction of noise—several makers can now supply 'noiseless' models, which are quiet, if not altogether silent—and to the production of electrically-operated machines.

There has, of course, been a good deal of collateral development as well. We have typewriters which will write in bound books, typewriters which will calculate, typewriters which can write phonetically and

FIG. 18. *Remington No.* 10 (1907), *the first Remington model to change in general design from the 'invisible writing' of the Sholes-Densmore to the 'visible writing' of Underwood No.* 1.

produce readable text (not shorthand) at ordinary talking speed, typewriters which can be worked, from a distance, by 'remote control'. Yet the biggest achievement of the typewriter, or rather, of the many men who have spent their lives in perfecting it—does not, I think, lie in any of these directions but rather in the enormous social change which it has brought about—the emancipation of millions of women from household drudgery to the position of wage-earners. As Sholes put it, in one of the last letters he ever wrote:

> 'Whatever I may have felt, in the early days, of the value of the typewriter, it is obviously a blessing to mankind, and especially to womankind. I am glad I had something to do with it. I builded wiser than I knew, and the world has the benefit of it.'

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